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ABSTRACT

Almost all preschool screening programs depend entirely on information and observations obtained during a brief evaluative session with the child. However, the logistics involved in managing large numbers of parents and children, the use of volunteers having varying degrees of sophistication or competency in assessment, the reliability and validity of such data, and the time and cost required for such approaches suggest that adjuncts or alternatives to such direct testing programs should be explored. In this paper, the potential usefulness of parent reports in preschool screening as an alternative or supplement to direct examinations of children is examined through a review of 7 research studies encompassing 1,413 children and using both subjective and objective outcome criteria. Overall, the data strongly support the use of parent questionnaires as a means of obtaining useful and economical information about the potential difficulty a pre-kindergarten child may have during the primary school years. (Author/MP)

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Prediction of School Performance from the Minnesota Child Development Inventory: Implications for Preschool Screening

"The Minnesota Child Development Inventory: Ten Years Later:" A Symposium presented at the 90th Annual Meeting of the American Psychological Association Washington, D.C., August 21, 1982

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Introduction

There is little need to emphasize the importance of early identification of the child who is at risk for difficulty in mastering school tasks because of the implications for early intervention. However, there is much controversy over the means for carrying out such programs of early screening and intervention.

Almost all preschool screening programs depend entirely on information and observations obtained during a brief evaluation session with the child. However, the logistics involved in managing large numbers of parents and children, use of volunteers having varying degrees of sophistication or competency in assessment, reliability/validity of such data obtained during such an abbreviated assessment session, as well as the time and cost required for such approaches, suggest that adjuncts or alternatives to such direct testing programs be explored.

This paper will report on a series of studies involving more than 600 preschool children as well as investigations carried out by others involving nearly an equal number will also be discussed.

Initial studies

The impetus for this series of studies was prompted by questions raised about the traditional preschool physical examination. In Minnesota it is customary for parents of preschoolers to have their child's health status assessed by their family physician prior to entering kindergarten. This examination usually consists of a history review, including immunizations and tuberculin tests, brief physical examination, visual/hearing screening, measurement of height, weight, blood pressure, and urinalysis. In our part of Minnesota 88% of the children entering kindergarten in 197[illegible] had such an examination.

However, at that time some pediatricians and family practitioners were raising serious questions about the usefulness of this examination and the cost to parents, as well as the time required by physians and nurses, because of the low yield of physical findings. A review of 382 medical records of children coming to Mayo Clinic for pediatric preschool examinations found this group of children had been examined an average of 14 times prior to the preschool physical!

Since family practitioners and pediatricians are concerned about the "whole child" in the context of family and school, it was decided to attempt to extend this preschool assessment to include psychological and behavioral factors which might adversely effect school learning. (Colligan and O'Connell, 1974).

To do so, following the direction provided by the voluminous literature available at that time, a preschool screening battery consisting of four parts was developed (intellectual functioning, behavioral observations, preacademic

readiness assessment, parent report of language skills).

A pilot study using this screening battery, as a supplemental component to the pediatric physical examination, was carried out with a sample of 165 pre-kindergarten children (84 boys; and 81 girls). When the achievement levels of 135 children from the pilot sample were assessed at the close of the kindergarten year, our preschool screening battery was found to be effective (R range= .69-.77) in predicting reading competency. Equally strong results were obtained for the child's learning in arithmetic (R=.72).

To our surprise, however, a prominent component of the regression equation was the information provided by parents, regarding the child's use of language, an item we had included, at least in part, because it occupied the parent during the child's assessment session. In addition, three of the other pieces of information which we obtained during direct assessment, the child's knowledge of letters and numbers, fine-motor skill, and name-printing, could have been obtained as easily from parent report.

Two other demographic items, socio economic status and the child's sex, were also pieces of information not requiring direct assessment.

Thus, much to our chagrin, we found that all of the pieces of information which we had found to be effective in predicting kindergarten learning success - items no different from those reported by others in the literature - could all have been obtained without requiring the child's presence! While we were not willing, on the basis of this pilot study, to suggest termination of direct assessment, we found these data provocative and a decision was made to pursue parent report as systematically as possible.

That this information should be so useful is hardly unique. It has long been known that observations of teachers are of significant value in screening. In addition, it has also been equally demonstrated that observations of mothers are relatively accurate regarding their child's intellectual capabilities and that parent report is useful in evaluating developmental delay/disability.

As a result of this pilot study an effort was made to review developmentally oriented parental questionnaires for preschoolers, and the MCDI, at that time called the Child Development Inventory, was selected because of its normative match with our patient population.

Subsequently we evaluated 559 children with our preschool screening battery (which now included the Child Development Inventory for parents) as we had for the pilot study, as part of a pediatric preschool examination.

Three years later we were able to locate 338 (60%) of these children for follow-up assessment. Although the results of the kindergarten pilot follow-up had been encouraging, they were of questionable value because a kindergarten program provides insufficient formal academic instruction to permit very meaningful appraisal of academic achievement. The three year follow up obtained more sophisticated criterion measures of achievement. Both objective and subjective measures were obtained. Objective assessment of reading skills was carried out with the Peabody Individual Achievement Test. Teacher ratings regarding the child's mastery of reading and arithmetic and readiness for the next grade were also obtained as subjective criteria of learning competence.

Significant multiple correlations (R=66, 52 for arithmetic and reading respectively) were obtained, with the MCDI conceptual comprehension scale being included in the regression equation for arithmetic, but with the highest values obtained from the direct measure of the child's knowledge of letters and numbers. This was also true for multiple correlations with the (subjective) kindergarten teacher ratings, with the MCDI data not being present in any of the regressions.

For children having completed grade one, significant multiple correlations with the preschool screening battery (R=.68, .67) for arithmetic and reading respectively were obtained. The MCDI scales for GD, EL and GM (as a moderator variable) were included for reading recognition but not arithmetic. The reading comprehension subtest was also completed by these first grade children with a significant multiple R=.69 being obtained; the EL, and FM scales were included in this regression equation. However, the direct assessment of letter and number skills continue to be of greatest statistical value.

Significant multiple correlations (R=68, 73 for reading and arithmetic respectively) were also obtained with subjective teacher ratings in those areas. The MCDI-CC scale entered the regression equation for arithmetic, but not for reading, with direct assessment of letters and numbers being of greatest significance.

Children having completed grade two also had preschool screening scores significantly correlated (R=.60, .67) with arithmetic and reading respectively and also with reading comprehension (R=.58). Direct measures of letter and number skills were of primary significance; this was also true for subjective ratings of classroom teachers.

This follow-up study (Bellamy, 1976) thus determined that our simple-minded direct measures of preschool knowledge of letters and numbers were the most highly correlated measures with later assessment of academic achievement, whether assessed subjectively by teacher observation or objectively by an individually administered achievement test.

We had assumed that the extensive data obtained from the MCDI would be more useful in this regard since we felt they would provide us with information about underlying substrata of language, visual-perceptual, or other abilities or competencies necessary for successsful completion of the direct letters and numbers tasks which were carried out during the direct assessment portion of the screening battery. Since it was obvious that this was not the case, we therefore turned our attention to specific items within the MCDI since the information we obtained by direct assessment of letter and number skills was also available, in a general way, in the MCDI item pool.

A prior study evaluating the effectiveness of a parental questionnaire and its usefulness in predicting kindergarten achievement had been carried out as part of a factor analytic study of an extended MCDI (Rogers, 1975). Unfortunately, this research was carried out as a masters thesis and was not published. It is instructive, however, to review Rogers' findings.

Rogers constructed and standardized a developmental inventory for the prediction of end-of-kindergarten achievement. He also compared the intuitive or rational method of scale construction with results obtained from factor analysis.

Rogers indicates (page 47, 48) that 60 items from the MCDI which were appropriate for the pre-kindergarten age, and some items between the 3-3½ year age level related to kindergarten readiness, were included. These were supplemented by 20 additional items representative of the developmental behavioral repertoire of 5-year old children. These items were used to rationally construct the following scales: conceptual language (40 items), perceptual-motor (20 items), personal-social (20 items).

It should be kept in mind that the 32 items taken from the MCDI expressive language, comprehension, conceptual-comprehension and situation-comprehension subscales were supplemented by 8 additional items from Gesell and Ilg. The perceptual motor scale consisted of 17 items from the MCDI gross/fine motor scale supplemented by 3 additional items. The personal-social scale consisted of 11 items from the MCDI self-help and personal social scale supplemented by 9 additional items. Rogers also included a fourth sacle (General Development) consisting of the sum of the 3 other scales.

Three hundred and eleven children, almost evenly divided by sex, and ranging in age from 4 years 10 months to 5 years 9 months were included in the normative sample. About 75% of the sample (112 boys, 108 girls) returned usable

questionnaires. This sample represented a cross section of white middle-class children who were an average of 64 months of age prior to the start of kindergarten. Parents were both in their early thirties with a mean education of approximately 14 years. About 30% of Rogers' sample were professional or managerial in occupation, with an additional 6% being college students. Only 16% were described as being general laborers.

Subsequently Rogers obtained results from the Metropolitan Readiness Test to 99 boys and 88 girls from his original sample. Results of the MRT were used as the criterion measure of achievement.

A principle components analysis with varimax rotation yielded a 5-factor solution carried out separately on the sample of boys and girls in the normative sample.

The five factors, their labels, and the proportion of variance explained by each factor are described below.

Boys: Factor I - general academic development (43%)

The 14 items having a factoral loading of .35 or greater are listed below.

** L 1. Recognizes and names all of the letters of the alphabet (.69).
*2. Spells simple words, such as cat, dog, yes, no (.66).
*3. Prints first and last name (.66).
L 4. Recites the alphabet in order (.64).
M 5. Does simple number additions up to ten such as 2+2, 3+5, 1+4 (.59).
L 6. Prints two or more simple words from memory (.57).
L 7. Reads four or more words (.57).
L 8. Recognizes the names of at least five capital letters (.53).
N 9. Prints the numbers 1 through 9 (.52).
*10. Names the days of the week in correct order (.51).
N 11. Counts to 100 by ones without help (.47).
L 12. Prints a few simple words from a copy (.44).
*13. Tells where he/she lives by street and number (.43).
L 14. Prints first name (.42).

*=supplemental Gesell items.

**L,N=item present on MCDI-L or N Scale

Girls: Factor I - general academic development (47%)

The 16 items loading more than .35 or greater are listed below.

L 1. Recognizes and names all of the letters of the alphabet (.70).

L 2. Recites the alphabet in order (.68).
L 3. Recognizes and names at least five capital letters (.62).
L 4. Prints two or more simple words from memory (.62).
L 5. Reads four or more words (.56).
L 6. Prints first name (.55).
*7. Spell simple words such as cat, dog, yes, no (.53).
*8. Prints first and last name (.53).
9. Knows right hand from left hand (.51).
N 10. Prints the numbers from 1 through 9 (.45).
*11. Tells where he/she lives by street and number (.44).
*12. Distinguishes between front and back of clothes and puts them on correctly (.44).
N 13. Does simple number additions up to ten such as 2+2, 3+5, 1+4 (.42).
*14. Names the days of the week in correct order (.42).
*15. Identifies red, green, yellow and blue by name correctly (.41).
*16. Tells birthday saying month and day (.36).

Correlations between the general development, conceptual-language and perceptual-motor skills and results of the MRT ranged from .48 to .55 with the personal-social scale correlating .22-.26 with the MRT.

Correlations between the achievement factor and the MRT ranged from .49 for boys to .59 for girls. Multiple regression analysis did not improve these correlations singificantly, although factor 2, (perceptual motor development-18% of the variance) obtained an almost equally high simple correlation (.47) for boys, but this was not true for girls (.43).

Factor 2 for boys accounted for 18% of the variance; the 11 items having loadings of .35 or greater are listed below:

1. Draws a picture of a man or woman that has at least three parts such as head, body, arms, legs, eyes, nose, mouth (.70).
2. Draws or copies a square (.59).
3. Draws simple designs (.59).
4. Draws pictures which include more than one object such as a house and a tree, a man and a dog, etc. (.55).
5. Draws recognizable pictures (.53).
*6. Cuts and pastes objects onto paper (.52).
7. Draws a picture of a man or a woman that has at least six parts - for example head, body, arms, legs, eyes, nose, mouth, hands, feet, hair or ears (.49).

8. Draws or copies circles (.49).
9. Cuts with scissors, following a simple outline or pattern (.44).
10. Makes things out of boxes, spools, paper clips or other odds and ends (.40).
11. Draws or copies a cross (.39).

Apparently Rogers used the total score from the Metropolitan Readiness Tests as criterion, also apparently excluding subtest correlations. This is unfortunate since some MRT subtests are reported by clinicians to correlate more highly with later school success than does the summary score.

Later Studies

Although we were pleased with the correlations between MCDI scales and measures of academic achievement, it was decided to construct two sub-scales based on our experience in obtaining information from direct assessment of the child, which could also be obtained from parents, namely, knowledge of letters and numbers.

Therefore, by inspection, 7 items approximating the information we obtained during direct assessment of the child's preschool reading readiness were identified. These composed the L Scale and included (listed by MCDI item number):

62. Prints first name (FM-55 months).
215. Prints a few simple words from a copy (FM-m 58 months; f 56 months).
151. Recognizes and names at least five capital letters of the alphabet (CC-57 months).
111. Recites the alphabet in order (CC-65 months).
22. Prints two or more simple words from memory (CC-m 71; f 68 months).
297. Recognizes and names all the letters of the alphabet (CC-81 months).
223. Reads four or more words (CC-72 months).

We also identified 9 items which, again by inspection, approximated information regarding the child's knowledge of numbers as we had assessed it directly during the screening session.

These items composed the N Scale and included (listed by age placement):

19. Counts three or more objects (CC-32 months).
20. Counts to ten (CC-36 months).
238. Knows what "half" means (CC-38 months).
144. Knows how many fingers there are on each hand (CC-44 months).
256. Knows the meaning of first, last, middle, and second and correctly follows directions using these words (CC-50 months).

246. Uses money to buy things (CC-52 months).

14. Prints the numbers 1 through 9 (CC-68 months).

150. Counts to 100 by ones without help (CC-72 months).

231. Does simple number additions up to ten such as 2+2, 3+5, 1+4 (CC-72 months).

We then obtained a new sample of 59 pre-kindergarten children (92% of the total number of children enrolled for kindergarten the following Fall) in a small school system close to Rochester. Parents completed the MCDI during kindergarten roundup. Scoring was done by psychology technicians; results were not made available to teachers or other school personnel during the kindergarten year.

The following May, one year after the parents had completed the MCDI, each child was individually administered the lower levels of the Wide Range Achievement Test to determine the pre-reading and number skills which had been attained.

In addition to this individually administered measure, two group tests (Lippincott Reading Readiness Test, Metropolitan Readiness Test) appropriate for end of kindergarten youngsters and which purport to measure academic readiness, were also administered.

Correlations between the MCDI, administered prior to the start of school, and the results of the three achievement measures were substantial for both boys and girls, although stronger for girls. The best predictor of kindergarten success in reading, as assessed by the WRAT, was the MCDI-L scale (i.e. the parents report of letter or word knowledge) yielding a simple correlation of .75. The MCDI-N scale (i.e. parents report of number knowledge) yielded a correlation of .56 with the measure of arithmetic skill from the WRAT. Correlations of a similar magnitude were obtained between the MCDI and the MRT and the LRRT. Obviously there is great similarity of content between these three tasks, although the LRRT and MRT are group administered tests while the WRAT data were obtained individually from each child. It should be kept in mind that the MCDI had been administered one year in advance of the LRRT and MRT, yet correlated as well with the LRRT even though it had been administered one year earlier!

(Correlations between the WRAT reading subtest and the LRRT were .98 for boys and .90 for girls; between the LRRT and the MRT were .75 for boys and .66 for girls; WRAT arithmetic correlated .70 with the LRRT and .76 with the MRT for boys and .51 with the LRRT and .78 with the MRT for girls.)

Since the magnitude of the correlations was not equal for boys and girls, we felt that other factors, for example age, educational level of parents, AM or PM kindergarten session, may have had an effect on the outcome measured, in

addition to the variables assessed by the MCDI. However from the 18 variables obtained prior to the start of school, regression analysis only identified a two-variable regression equation that accounted for 62% of the variance in the WRAT reading score (multiple R=.79). This equation weighted the MDCI-L score with a factor from the self-help scale of the MCDI (which seemed to function as a moderator variable) and yielded a standard error of measurement of 3.4 raw (WRAT) points.

Three year follow up

While these findings supported the contention that direct observation and psychoeducational assessment might not be crucial for preschool screening to identify children who require more comprehensive evaluation. However, a kindergarten program provides insufficient formal academic instruction to permit meaningful appraisal of learning accomplishments. Therefore, a three year followup was carried out at the end of grade 2 in order to obtain more sophisticated criterion measures of basic academic skills (Colligan, 1981).

The subjects were the same children whose parents had completed the MCDI prior to kindergarten, and who had been re-assessed at the end of the kindergarten year. Complete re-assessment data on 50 children were available for analysis at the close of 2nd grade.

The analysis was composed of two parts.

The first focused primarily on the accuracy with which MCDI data could predict a child's difficulty in mastering reading over the three year period. Therefore, the children were classified into one of four categories, based on the amount of supplemental instruction which needed to be provided from kindergarten through grade 2. The continuum of supplemental instruction is viewed as a representation of a corresponding continuum of difficulty in mastering reading:

Category 1 - No difficulty: No supplemental instruction during kindergarten, first or second grade.

Category 2 - Mild difficulty: Supplemental instruction provided during either kindergarten or grade 1, but not during grade 2.

Category 3 - Moderate difficulty: Supplemental instruction provided during two or the three school years.

Category 4 - Severe difficulty: Supplemental instruction provided during all three years.

Using this classification system, 29 children were found to have no difficulty, 4 fell in the mild category, 12 had moderate difficulty, and 5 experienced severe

difficulty in mastering reading.

Second, in addition to the reading-difficulty classification system, more formal evaluation of basic reading skills was obtained by having each child complete the word-meaning and paragraph-comprehension subtests of the Stanford Achievement Test.

A corresponding two-part analysis was carried out.

In order of importance, the Numbers (r=.55), General Development (r=.52) and Letters (r=.47) scales were significantly correlated ($P \leq .001$) with the rating of supplemental instruction provided.

Since the General Development scale is composed of the most age discriminating items, one might speculate that the correlations with supplemental instruction represent a mild lag in general development.

The L and N scales are relatively short, yet they were as significantly related to the need for supplemental instruction as the general developmental scale. While it is somewhat surprising that the N scale should be more highly correlated with the need for supplemental instruction in reading than the L scale which might be viewed as a sample of pre-reading skill itself, the current finding replicates the results obtained by Bellamy. It should also be noted that the L & N scale items overlap considerable with Rogers' general academic development factor (80% of the top ten items are on the L or N scale for girls; 90% for boys).

The L scale also correlated highly (r=.60) with the word recognition subtest of the SAT and with paragraph comprehension (r=.51).

Stepwise discriminant analysis of the ten MCDI scales found the L scale to be the most effective in classifying children by their needs for supplemental instruction. No other scale added significantly to increase its discriminating power.

While these values are lower than the correlations obtained at the end of kindergarten they are still substantial.

A second level of analysis examined the "hit rate" or practical utility of the MCDI. While the Pearsonian correlations are exciting, it becomes clear that simple correlational analysis has obvious limitations when one turns to the discriminant function analysis.

Children were recombined into two groups, one having mild or no reading difficulty, and the other having moderate or severe difficulty. Of the 17 children who were rated as having moderate or severe difficulty (receiving two or three years of instruction) 14 (82%) were correctly identified from the score on the L scale - which had been obtained three years earlier before these

children had started school.

The remaining three children, incorrectly identified, had received two years of reading aid.

The five children with severe difficulty had received three years of supplemental instruction and all were correctly identified.

With regard to false positives, 27% (9) of the children who were in the no-difficulty or mild-difficulty categories were incorrectly identified as having potentially moderate to severe difficulty in mastering reading.

Subsequent Studies

Perhaps somewhat tangentially, but still of interest and of semi-practical value as well, were the findings of the MCDI items significantly discriminating between "problem" and "non-problem" children, four of the twelve items came from the L scale. This suggests that children demonstraing pre-academic competence in reading are less likely to be viewed as behavior problems at the pre-school level. It should be noted these subjects were matched for intellectual abilities with both internalizing and externalizing behavior patterns being included in the "problem" child category. The authors of this study (Garrity and Servos, 1978) utilized the rubric "adaptive behavior", a term certainly applicable to coping with the expectations of the kindergarten classroom.

Of greater direct significance to preschool screening, however, is the specialized version of the MCDI oriented specifically toward the child entering kindergarten (Ireton, et. al., 1981). The Minnesota Preschool Inventory (MPI) is composed of 87 statements taken from the upper levels of the MCDI. These items are grouped into four developmental scales, including (1) self-help (21 items), (2) fine-motor abilities (17 items), (3) expressive language (18 items), (4) comprehension (34 items).

Three subscales, derived from the comprehension scale were also developed by inspection; these include (1) memory (15 items), (2) letter recognition (7 items), (3) number comprehension (9 items). The letter recognition and number comprehension scales were based on the L and N scales just reported. The letter recognition subscale is identical to the L scale, with the number comprehension subscale containing two different items from the N scale.

In addition, a second portion of the MPI contains 63 statements describing possible adjustment problems and other symptoms. The adjustment scales include immaturity, hyperactivity, behavior problems, emotional problems, and symptom clusters in the area of motor, language, somatic, or sensory functioning.

In the Ireton study, 360 MPI's were obtained from the parents of pre-kindergarten children with 287 of these being available for followup at the end of kindergarten.

Criterion consisted of (1) a teacher rating scale, and (2) identification of the "poorest" students in the classroom (defined as being in the bottom 5% of the class). The letter recognition subscale correlated .56 with teacher ratings, with number comprehension correlating .24 (all beyond the .001 level).

Twenty students were rated as poor performers in kindergarten, with 12 of these being identified by low scores on letter recognition, number comprehension, memory, or the comprehension scale.

Although suffering from the limitations of using end-of-kindergarten teacher observations as criterion for academic difficulty, the data nevertheless provide additional cross validation for the L and N scales.

Studies Under Way

Since it is apparent that more comprehensive cross validation regarding the usefulness of the L and N scales is needed, a new sample of 230 preschool children (118 girls, 112 boys) was drawn from a different, but comparable, school district. Parents of these children completed a brief form containing the items from the L and N scales. The remainder of the MCDI / MPI was not completed because of time constraints. This sample of children represented approximately 25% of the total population of kindergarteners for that year (1978) in that school system.

Four years have now passed and the children have completed grade three. At this point a followup study is being carried out to determine reading competency as described in two ways. The first criterion is a measure of basic skills, obtained from the reading subtests (vocabulary, comprehension) of the California Achievement Tests. Second, each child is assigned a rating based on the amount of supplemental instruction provided; this continuum represents a corresponding continuum of difficulty in mastering reading, and is basically the same as that used in the initial three year followup reported earlier.

Summary

What are the practical implications of these data? The following suggestions can be defended:

1. It is apparent that direct examination of children is not crucial for an effective screening program. While such contact may be very desirable, it may also be prohibitively expensive in this time of budgetary constraints.
2. Should budgetary constraints limit the scope of the screening program, attention can be focused almost entirely on male students, with particular attention focused on "immature" or chronologically younger boys who demonstrate weaknesses in the acquisiton of number concepts and symbol recognition prior to the start of school.
3. Those charged with the responsibility for constructing or maintaining a screening program should be encouraged to include this type of parental report in their armamentarium.
4. It is important to state a relatively explicit definition of the specific area and degree of potential academic difficulty one wishes to identify; predictive studies of the type described in this report need to be carried out, within one's own encatchment area or school district, using both subjective and objective outcome criteria.
5. Finally, these data are certainly a positive response to Goodwin's review (8th Mental Measurements Yearbook, 1979) chiding the MCDI authors since Goodwin felt that validity of the MCDI had not, as of yet, been convincingly established.

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